THE BIOLOGY AND EARLY STAGES OF *HOMALOCEPHALA* (DIPTERA: ULIDIIDAE) IN BRITAIN

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According to his diaries, on 27 June 1905 Col. J. W. Yerbury and his colleague C. G. Lamb were collecting insects along the banks of the River Spey near Grantown. They were attracted by aspen stumps on which they found adults of the syrphid, *Hammerschmidtia ferruginea* (Fallén) and the ulidiid, *Psairoptera albitarsis* (= *Homalocephala biumbrata* Wahlberg (Andersson, 1991)). This was the first time these species had been found in Britain. The syrphid was exhibited at one of the autumn meetings of the Royal Entomological Society later that year (1905) [Exhibition Report], Transactions of the Royal Entomological Society xlvi–vii). Curiously, *Psairoptera albitarsis* is not recorded as being exhibited. Yerbury and Lamb probably passed on some of their specimens to Collin, as their presence in the Verrall–Collin collection shows. Based on this material, Collin (1910) introduced this species as new to Britain five years later. Apparently Collin often 'sat' on new findings while he accumulated data (Smith, 1962).

A second *Homalocephala* species, *H. bipunctata* (Loew) (= *H. albitarsis* Zetterstedt (Andersson, 1991)) was added to the British list by Cogan & Dear (1974). This was based on a specimen collected by H. Graber on 16 October 1952 in sappy wood from a stump of *Pseudotsuga menziesii* (Mirbel) Franco at Penicuik, Midlothian, and reared by E. B. Basden, the adult emerging on 1 July 1953. Basden sent the specimen to Collin who never published this second species as new to Britain. This again is curious because he already had a specimen, from Nethy Bridge on 9 July 1936 which he had probably collected himself. This second specimen is not mentioned by Cogan & Dear (1974).

During the course of work on saproxylic Diptera in Scotland we re-encountered both *Homalocephala* species and in this paper give details of their biology and describe their early stages. *Homalocephala biumbrata* is an RDB 1 species, considered to be endangered and close to extinction (Shirt, 1987; Falk, 1991). *Homalocephala albitarsis* is considered an RDB K species, thought to be threatened but further data required to clarify its status (Falk, 1991).

DESCRIPTION OF THE THIRD STAGE LARVA AND PUPARIUM *HOMALOCEPHALA BIUMBRATA* (WAHLBERG) (= *ALBITARSIS* AUCTT. NEC ZETTERSTEDT)

Larva subcyclindrical in cross-section, between 7 and 8 mm long with an inclined end segment bearing a pair of fleshy protuberances above pale brown breathing tubes (Figs 1 & 3), these tubes without projections. Mouth-hooks red-brown and blunt-tipped. Puparium subcyclindrical except for anterior end which is flattened dorsoventrally; end segment terminating in a smooth plate surrounded by ridges narrower than the diameter of the spiracular plate; anterior and posterior ends with inter-segmental ridges obscuring the segmental boundaries (Fig. 6).

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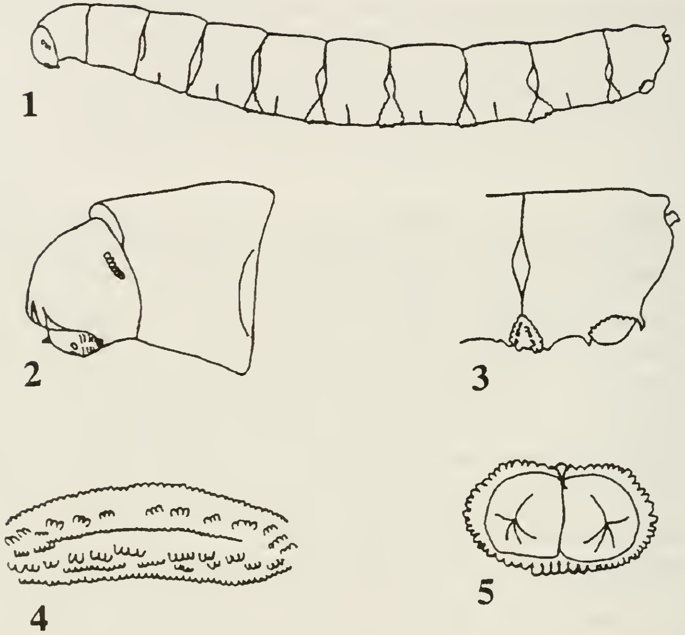
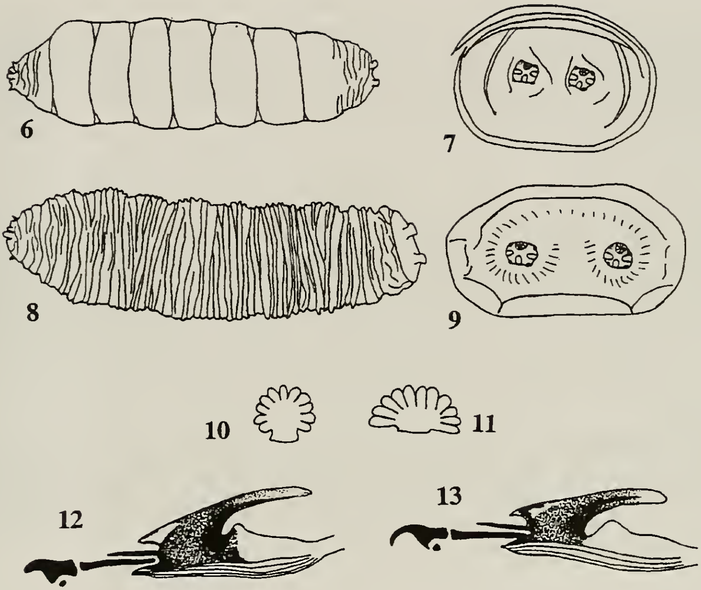


Figs 1–5. *Homalocephala biumbrata*, third stage larva. 1, whole larva, lateral view anterior end to the left; 2, lateral view of the head, prothorax and mesothorax; 3, lateral view of the end segments; 4, locomotory organ from the 4th abdominal segment, ventral surface; 5, anal lobes from the ventral surface of the end segment.

Diagnosis

Larva: length between 7 and 8 mm; width 0.8 mm; subcylindrical in cross-section, tapering anteriorly; end segment inclined dorsoventrally (Figs 1 & 3); integument smooth and shining with segment boundaries clearly delineated. Head: oral lobes (sited between the antennomaxillary organs and the mouth) large and coated in transverse ridges (Fig. 2). Cephalopharyngeal skeleton (Fig. 12): pharyngeal sclerite lightly pigmented except for hyaline areas on cornua; dorsal bridge, dorsal apodeme and ventral pharyngeal ridges present; pharyngeal and intermediate sclerites not fused; anterior end of intermediate sclerite heavily pigmented; parastomal bars extending forward almost to mouth-hooks; mouth-hooks red-brown, blunt and without accessory teeth; posterior part of mouth-hooks quadrate in shape; dental sclerites present. Thorax: anterior margin of prothorax folded down to meet head bearing longitudinal impressions or grooves (Fig. 2); anterior spiracles fan-shaped with 9–11 lobes (Fig. 10). Abdomen: each of the first six abdominal segments with locomotory organs comprising 5 rows of locomotory setae, the first two rows on the posterior margin of one segment and the remaining three on the anterior margin of the next segment (Fig. 4); second and fourth rows consisting of inclined groups of 3–8 setae. End segment: with a pair of fleshy protuberances above the breathing tubes (Figs 1 & 3); anus with two lobes indented at tip and anus surrounded by round-tipped, spatulate, locomotory setae (Fig. 5); anteriomedial row of 4–6 setae larger



Figs 6–13. *Homalocephala* puparia, 6, *Homalocephala biumbrata*, dorsal view; 7, end segment, apical view; 8, *Homalocephala albitarsis*, dorsal view; 9, end segment, apical view; 10, *H. biumbrata*, anterior spiracle; 11, *H. abitarsis*, anterior spiracle; 12, *H. biumbrata*, head skeleton, lateral view; 13, *H. albitarsis*, head skeleton, lateral view.

than others and, posteriorly, a single tapering projection about twice as long as locomotory setae (Fig. 5). Posterior breathing tubes (Fig. 7): each mounted on a short, light brown, sclerotized papilla; each papilla with 3 spiracular openings and 4 groups of interspiracular setae (often missing) on slight but darkened projections; circular scar on the anterior margin of the spiracular plate. Puparium: subcylindrical but anterior end flattened dorsoventrally; anterior and posterior ends with intersegmental ridges obscuring the segmental boundaries (Fig. 6); end segment terminating in a smooth plate surrounded by ridges which are narrower than the diameter of a spiracular plate; in the centre of the smooth plate are the posterior breathing tubes, separated by about 0.2 mm (Fig. 7).

Material examined

Four larvae collected by GER from Ord Ban nr Aviemore 25.v.1990; one puparium collected by GER from Speybridge, Grantown, 14.vi.1989 female emerged 23–28.vi.1989; 19 puparia (10 females and 9 males) collected by GER from Dulicht Wood, Grantown 22.vii.1990, adults emerged during June 1991. All this material collected in wet, decaying sap under bark of fallen *Populus tremula* L. trees and branches.

Distribution

Andersson (1991) records this species from Great Britain, Sweden, Finland and north-western USSR. In Britain it is only known from northern Scotland: in Sutherland, Wester Ross, Easter Ross, Nairn and Inverness-shire (MacGowan, 1993).

Biology

Puparia were apparently found by Wahlberg in 1839 among fallen leaves (Andersson, 1991). We found larvae and puparia only under bark of fallen *Populus tremula* L. The larva apparently feeds on the breakdown products of the decaying cambial layers caused by micro-organisms. Under the bark of fallen trees and branches a layer of decaying material tends to build up over a period of about 3 years. After this time the bark cracks, the sap dries out and becomes unsuitable as a breeding site. Thus a critical factor in the survival of this species is continuity of fresh fallen wood.

Adult *H. biumbrata* are found in June and July. They occur on the bark of fallen *P. tremula*, where they court, mate and oviposit. Occasionally, we encountered aggregations of up to 100+ puparia under *P. tremula* bark surrounding cracks and crevices. Possibly larvae about to pupate search out cracks under the bark where the emerging adult can readily escape the breeding site.

HOMALOCEPHALA ALBITARSIS ZETTERSTEDT (= BIPUNCTATA LOEW)

Larva subcyclindrical in cross-section, between 7 and 8 mm long with an inclined end segment bearing a pair of slight fleshy protuberances above pale brown breathing tubes (Figs 1 & 3), these tubes without projections. Mouth-hooks red-brown and sharply pointed (Fig. 13). Puparium subcyclindrical except for anterior and posterior ends which are dorsoventrally flattened; intersegmental ridges obscure the segmental boundaries so that the whole puparium appears wrinkled (Fig. 8); end segment terminating in a smooth plate.

Diagnosis

Larva: length between 7 and 8 mm; width 0.8 mm; cyclindrical in cross-section, tapering anteriorly; end segment inclined dorsoventrally (Figs 1 & 3); integument smooth and shining with segment boundaries clearly delineated. Head: oral lobes (sited between the antennomaxillary organs and the mouth) large and coated in transverse ridges (Fig. 2). Cephalopharyngeal skeleton (Fig. 13): pharyngeal sclerite lightly pigmented except for hyaline areas on cornua; dorsal bridge, dorsal apodeme and ventral pharyngeal ridges present; pharyngeal and intermediate sclerites not fused; anterior end of intermediate sclerite heavily pigmented; parastomal bars extending forward almost to mouth-hooks; mouth-hooks red-brown, sharply pointed and without accessory teeth; posterior part of mouth-hooks quadrate in shape; dental sclerites present. Thorax: anterior margin of prothorax folded down to meet head bearing longitudinal impressions or grooves (Fig. 2); anterior spiracles fan-shaped with 9–11 lobes (Fig. 11). Abdomen: each of the first six abdominal segments with locomotory organs comprising 5 rows of locomotory setae, the first two rows on the posterior margin of one segment and the remaining three on the anterior margin of the next segment (Fig. 4); second and fourth rows consisting of inclined groups of 3–8 setae. End segment: with a pair of fleshy protuberances above the breathing tubes; anus with two lobes indented at tip and anus surrounded by round-tipped, spatulate, locomotory setae (Fig. 5); anteriomedial row of 4–6 setae larger than others and, posteriorly, a single tapering projection about twice as long as locomotory setae (Fig. 5). Posterior breathing tubes (Fig. 9): each mounted on a short, light brown, sclerotized papilla; each papilla with 3 spiracular openings and 4 groups of interspiracular setae (often missing) on slight but darkened projections; circular scar on the anterior margin of the spiracular plate. Puparium: subcylindrical but anterior end flattened dorsoventrally with anterior and posterior ends with intersegmental ridges obscuring the segmental boundaries (Fig. 8); end segment terminating in a smooth plate surrounded by a ridge as wide as or wider than the diameter of the spiracular plate and in the centre of which are the posterior breathing tubes, separated by about 0.4 mm (Fig. 9).

Material examined

Three puparia from Penicuik, Midlothian: one collected by H. Graber emerged 1.vii.1953, now in the Verrall–Collin collection, Oxford University Museum; two collected as larvae 27.iv.1996 by DMR, male emerged 21.vi.1996, female emerged 11.vii.1996 and one larva, collected 29.iii.1997.

Distribution

Andersson (1991) records this species from Great Britain, Germany, Norway, Poland, Sweden, Finland, north-western USSR and North America. In Britain it is known from Duncombe Park, nr Helmsley, Yorkshire, where a female was collected on 10.vi.1980 by P. Skidmore and from Nethy Bridge, Inverness-shire where a female was collected on 9.vii.1936, probably by J. E. Collin and from Penicuik Estate, Midlothian. Thus in Britain our data suggests that this species is similarly northern in distribution but more widespread than *H. biumbrata*. It is, however, known from fewer sites and is possibly under-recorded.

Biology

Puparia were apparently found by Wahlberg in 1839 under the bark of rotting *Pinus* in Norway and Sweden (Allen & Foote, 1967; Andersson, 1991). H. Graber found a larva in a stump of *P. menziesii*. However, we found larvae under bark of a *Fagus* stump. The female collected by P. Skidmore from Yorkshire is very teneral and was on a dead *Fagus* suggesting that it shared the same breeding site as our specimens. As in *H. biumbrata*, the larva apparently feeds on the breakdown products of the decaying cambial layers caused by micro-organisms.

DISCUSSION

The biology of Ulidiidae (including Otitidae) is poorly known and summarized by Allen & Foote (1967) and Ferrar (1987). A range of larval feeding modes occur in the family from saprophagy to phytophagy and a number of species in several genera have been reared from under bark. In comparison with larvae of other families found under bark, those of the two *Homalocephala* species examined here are most similar to larvae of *Chymomyza* and *Stegana* (Drosophilidae) and *Palloptera* (Pallopteridae) Czerny. However *Homalocephala* larvae can be separated from these groups by their red-brown mouth-hooks. Mouth-hooks are black in drosophilid and pallopterid larvae. In relation to other ulidiids, comparisons with figures in Ferrar (1987) show that larvae of *Homalocephala* most closely resemble those of *Eumetopiella* Hendel in general shape, form and in the structure of the larval head skeleton and posterior breathing tubes. However *Eumetopiella* is a new world genus and phytophagous on grasses (see Ferrar, 1987). *Homalocephala* larvae seem to be separated from other ulidiid larvae, including *Eumetopiella*, by the following combination of characters: mouth-hooks lacking accessory teeth; head skeleton with intermediate sclerite long and thin, without a broad mid-section, and posterior breathing tubes with spiracular openings about as long as broad.

The larva of *H. albitarsis* is easily separated from that of *H. biumbrata* in having sharply pointed mouth-hooks compared with the blunt ones of *H. biumbrata* (Figs 12 and 13). The puparia can also be separated by this character and also by the heavily wrinkled puparium and posterior breathing tubes being more widely separated in *H. albitarsis* compared with smooth puparium and posterior breathing tubes being closer in *H. biumbrata* (Figs 6 and 8, 7 and 9, respectively).

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